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(54) A catheter structure for use in medical treatment

(57) In a catheter structure having an inner tube, a metallic mesh knit provided to surround an outer surface of the inner tube and an outer tube provided to cover an outer surface of the metallic mesh knit, the metallic mesh knit is formed by spiral lines, one of which is greater than the other in mechanical strength.

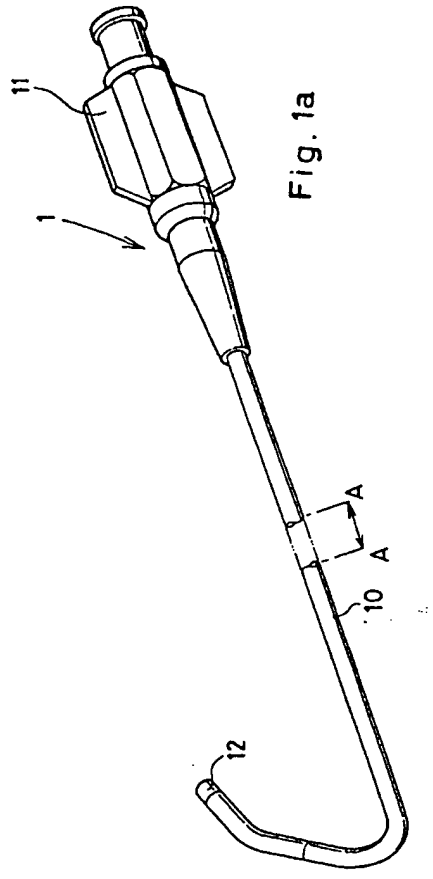

Fig. 1a

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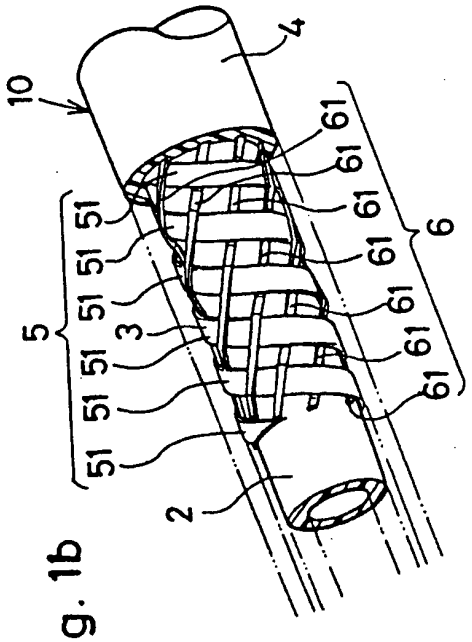


Fig. 1b

Description

The invention relates to a catheter structure usually used for medical treatment to improve its manipulatability.

In a catheter structure which has an synthetic inner tube, a metallic mesh knit provided to surround an outer surface of the inner tube and an outer tube provided to cover an outer surface of the metallic mesh knit, the metallic mesh knit is made of flat thin wires of the same mechanical strength substantially knitted with equal pitch and angle.

In this type of the catheter, it is difficult to concurrently overcome conflicting requirements between its structural property and functional property. When the thickness of the metallic mesh knit is reduced, its kink resistance property and good torque transmission is sacrificed although it better follows up a blood vessel due to an increased flexibility. When the thickness of the metallic mesh knit is increased, its follow-up property and inner diameter are reduced with less flexibility although the kink resistance property and good torque transmission are improved.

With the reduced diameter of the metallic mesh knit, there arises a problem of increasing vessel pressure when supplying contrast medium with the blood vessel. When a guide catheter is used, there arises a problem of impeding passage of a balloon catheter and a stento.

Therefore, it is an object of the invention to provide a catheter structure which is capable of improving a kink resistant and good torque transmission property while maintaining a good follow-up property without reducing its inner diameter.

These together with other objects and advantages which will become subsequently apparent reside in the details of construction and operation as more fully hereinafter described and claimed, reference being had to the accompanying drawings forming a part hereof.

Fig. 1a is a prespective view of a catheter structure according to an embodiment of the invention;

Fig. 1b is an enlarged prespective view of a main part of the catheter structure taken along the line A-A of Fig. 1a but partly removed; and

Figs. 2a - 2d are sequential views of the main part of the catheter structure showing how the catheter is assembled.

According to the invention, there is provided a catheter structure comprising an inner tube, a metallic mesh provided to surround an outer surface of the inner tube and an outer tube provided to coat an outer surface of the metallic mesh; the metallic mesh being formed by spiral lines, one of which is greater than the other in mechanical strength.

Normally, the mesh is woven or "knit".

With the structural arragement that the metallic mesh being formed by spiral lines, one of which is greater than the other in mechanical strength, the spiral line of weaker strength surrenders to bend around other spiral line at the intersection of the two spiral lines. This increases a sliding resistance of the weaker spiral line against the other at the intersection so as to improve the kink resistant and torque transmission property necessary to manipulate the catheter without increasing its thickness dimension.

According to a preferred feature of the invention, each of the spiral lines comprising a one thin fiber or pluralistic thin fibers, the thin fiber of one spiral line being greater than the thin fiber of the other spiral line in cross section.

According to still another preferred feature of the invention, both the thin fiber of one spiral line and the thin fiber of the other spiral line are rectangular in cross section, at least either width or thickness of the former thin fiber is greater than the latter thin fiber.

According to other option of the invention, the width of the former thin fiber is 2.5 - 25 times the latter thin fiber, and the thickness of the former thin fiber is 1.0 - 10 times the latter thin fiber.

According to other option of the invention, each of the spiral lines comprising one thin fiber or pluralistic thin fibers, the thin fiber of one spiral line being greater than the thin fiber of the other spiral line in hardness.

According to other option of the invention, each of the spiral lines comprising a one thin fiber or pluralistic thin fibers, the thin fiber of one spiral line being greater than the thin fiber of the other spiral line in geometrical moment of inertia.

According to still other option of the invention, one spiral line is made of stainless steel, and the other spiral line made of a synthetic resin.

According to still other option of the invention, both the thin fiber of one spiral line and the thin fiber of the other spiral line are circular in cross section, a diameter of the former thin fiber is dimensionally greater than the latter thin fiber.

According to still other option of the invention, a cross section of one spiral line is substantially the same that of the other spiral line, and the number of the former thin fibers is greater than that of the latter.

Referrig to Fig. 1a, a catheter 1 has a catheter body 10 and a grip 11 provided at a rear portion of the cathether body 10. To a front end surface of the cathether body 10 which is made of a flexible tube, a soft tip 12 is connected. As shown at an enlarged view in Fig. 1b, the cathether body 10 has an inner tube 2 made of a synthetic resin. An outer surface of the inner tube is surrounded by a metallic mesh knit 3 which is coated by an outer tube 4 made of a synthetic resin. The metallic mesh knit 3 comprises a series of counterclockwise spiral lines 5 and a series of clockwise spiral lines 6.

The spiral line 5 is adapted to be mechanically stronger than another spiral line 6 in the following manner.

The spiral line 5 includes eight thin fibers 51, each

of which is flatly compressed into sash-like structure which measures 0.26 mm in width and 0.06 mm in thickness. Each of the thin fibers 51 is originally made of a stainless steel wire which measures 0.12 mm in diameter. In this instance, the stainless steel wire of the thin fiber 51 is usable so long as its diameter is below 0.2 mm with its Vicker's hardness (Hv) ranging from 180 to 750. It is preferable that the compressed thin fiber 51 measure 0.05 mm - 0.50 mm in width and 0.01 mm - 0.10 mm in thickness. The number of the thin fibers 51 can be altered appropriately within the range of 1 - 24.

On the other hand, another spiral line 6 includes eight thin fibers 61, each of which is flatly compressed into sash-like structure which measures 0.13 mm in width and 0.03 mm in thickness. Each of the thin fibers 51 is originally made of an annealed stainless steel wire which measures 0.07 mm in diameter. In this instance, the stainless steel wire of the thin fiber 61 is usable so long as its diameter ranges from 0.04 mm to 0.12 mm with its Vicker's hardness (Hv) ranging from 50 to 210. It is preferable that the thin fiber 61 measures 0.02 mm - 0.20 mm in width and 0.01 mm - 0.10 mm in thickness. The number of the thin fibers 51 can be altered appropriately within the range of 1 - 24.

The method of manufacturing the catheter 1 is as follows:

(1) The inner tube 2 is made by extruding or blowing the synthetic resin over an outer surface of a metallic core 1A as shown in Fig. 2a.
(2) On the outer surface of the inner tube 2, the eight numbers of thin fibers 51 and the thin fibers 61 are knitted together to form the metallic mesh knit 3 as shown in Fig. 2b.
(3) After knitting the these thin fibers 51, 61, the thin fiber 61 is yieldingly bent to form a hook portion against another thin fiber 51 at each of the intersection of the thin fibers 51, 61.
(4) The outer tube 4 is made by extruding or blowing the synthetic resin over the outer surface of the metallic mesh knit 3 as shown in Fig. 2c.
(5) The metallic core 1A is axially stretched to reduce its diametrical dimension, and the core 1A is pulled out of the inner tube 2 as shown in Fig. 2d.

With the thin fiber 61 yieldingly bent against another thin fiber 51, the thin fiber 61 entangles with another thin fiber 51 so as to increase the mechanical strength of the metallic mesh knit 3. This makes it possible for the catheter to favorably follow up the blood vessel while maintaining a good kink resistant and torque transmission property.

In the foregoing embodiment of the invention, the cross sectional area and the hardness are discretionally altered to provide the difference of the mechanical strength between the two types of the thin fiber 51, 61, the difference of the mechanical strength may be added as follows:

(a) Instead of the annealed stainless steel, the thin fiber 61 of the spiral line 6 may be made by polyamide, polypropylene or the like.
(b) It is observed that the spiral line 5 and another spiral line 6 have common cross sectional area or geometrical moment of inertia, but the former line 5 is made by anneal thin fibers, and the latter thin fiber made by quenched thin fibers.
(c) In the method of manufacturing the catheter, a step of compressing the metallic mesh knit 3 is not always necessary. Without compressing the metallic mesh knit, the thin fiber 61 is yieldingly bent against the thin fiber 51 at their intersection, thus substantially improving the kink resistant and torque transmission property.
(d) The thin fibers 51, 61 may be circular in cross section, and a diameter of the former is greater than that of the latter.
(e) The thin fibers 51, 61 may be circular in cross section, and the diameter of the former is the same that of the latter. The number of the thin fibers 51 may be counted greater than the thin fibers 61.

While the invention has been described with reference to the specific embodiments, it is understood that this description is not to be construed in a limiting sense in as much as various modifications and additions to the specific embodiments may be made by skilled artisan without departing from the spirit and scope of the invention.

Claims

1. A catheter structure comprising an inner tube, a metallic mesh knit provided to surround an outer surface of the inner tube and an outer tube provided to coat an outer surface of the metallic mesh;
the metallic mesh being formed by spiral lines, one of which is greater than the other in mechanical strength.

2. A catheter structure as recited in claim 1, wherein each of the spiral lines comprises one or more thin fibers, the thin fibers of one spiral line being greater than the thin fiber of the other spiral line in cross-section.

3. A catheter structure as recited in claim 2, wherein both the thin fibers of one spiral line and the thin fibers of the other spiral line are rectangular in cross-section, and the width and/or thickness of the former thin fibers are greater than those of the latter thin fibers.

4. A catheter structure as recited in claim 3, wherein the width of the former thin fibers is 2.5 - 25 times that of the latter thin fibers, and the thickness of the

former thin fibers is 1.0 - 10 times that of the latter thin fibers.

5. A catheter structure as recited in any preceding claim, wherein each of the spiral lines comprises one or more thin fibers and the thin fibers of one spiral line are greater than those of the thin fibers of the other spiral line in hardness.

6. A catheter structure as recited in any preceding claim, wherein each of the spiral lines comprises one or more thin fibers and the thin fibers of one spiral line are greater than the thin fibers of the other spiral line in geometrical moment of inertia.

7. A catheter structure as recited in any preceding claim, wherein one spiral line is made of stainless steel, and the other spiral line is made of a synthetic resin.

8. A catheter structure as recited in any preceding claim, wherein both the thin fibers of one spiral line and the thin fibers of the other spiral line are circular in cross-section, the diameters of the former thin fibers being dimensionally greater than those of the latter thin fibers.

9. A catheter structure as recited in any preceding claim, wherein the cross-section of the fibers in one spiral line is substantially the same as those of the other spiral line, and the number of the thin fibers in the one spiral line is greater than the number of fibers in the other spiral line.

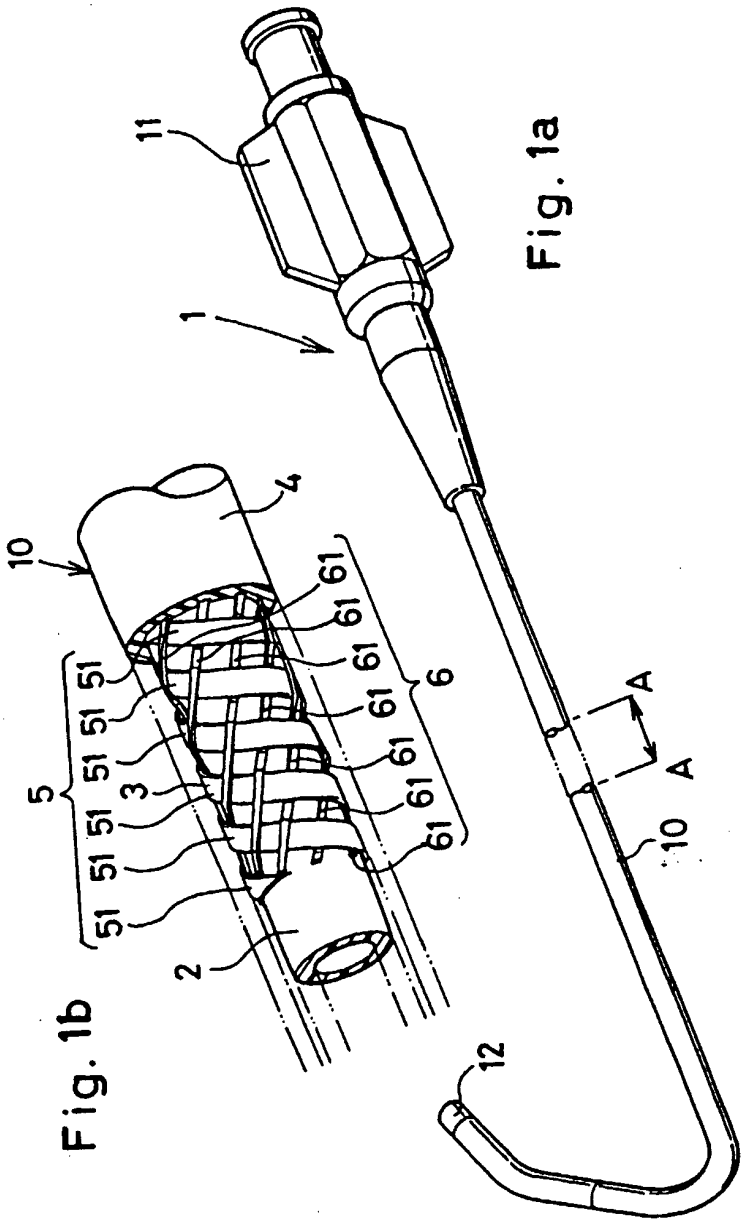


Fig. 1a

Fig. 1b

Fig. 2a

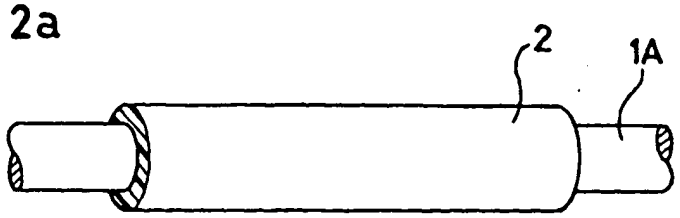


Fig. 2b

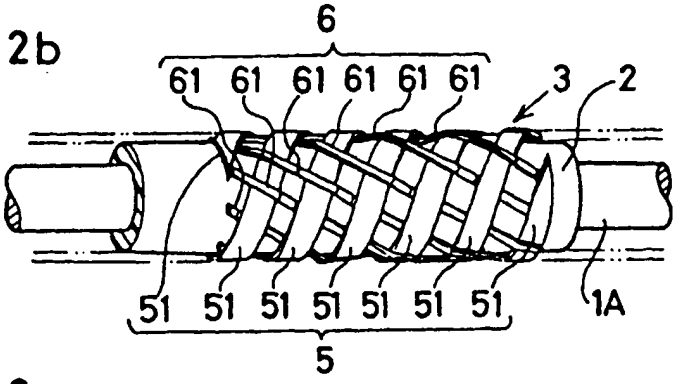


Fig. 2c

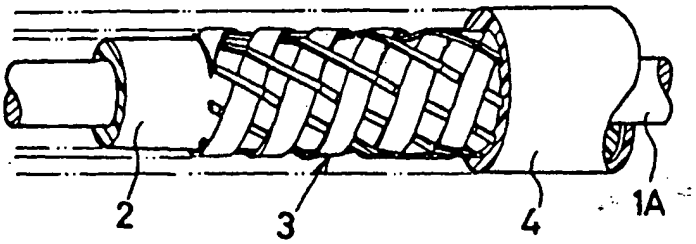
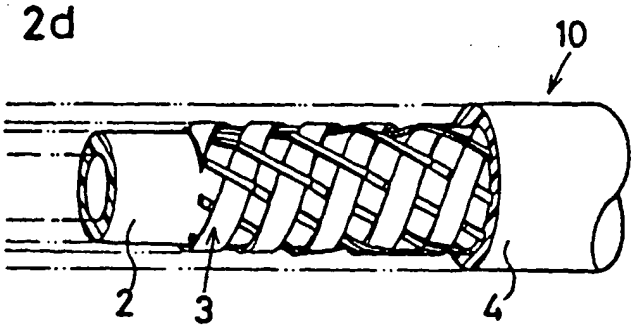


Fig. 2d



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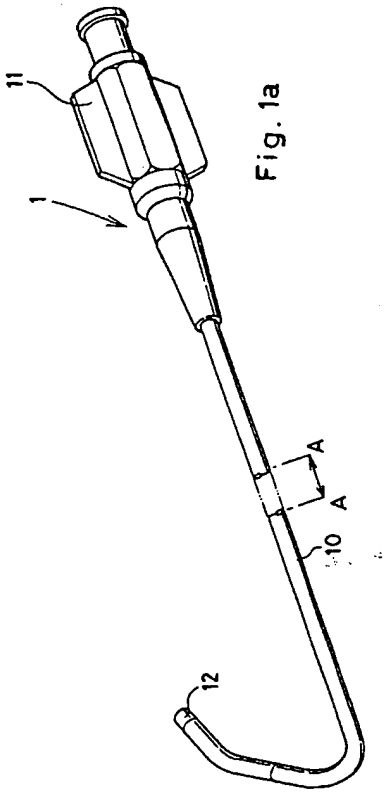

Fig. 1a

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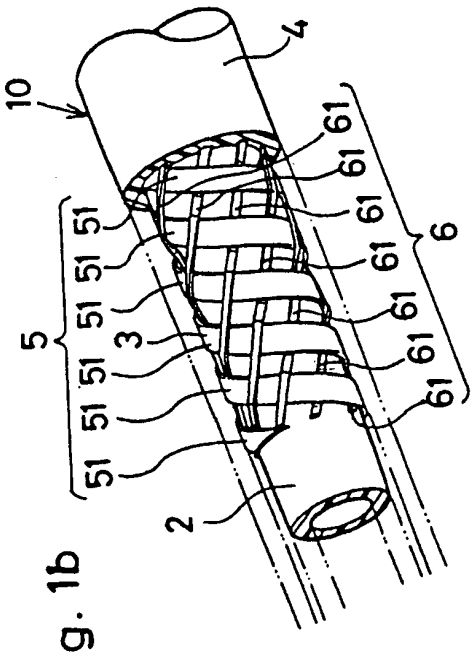

Fig. 1b

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EUROPEAN SEARCH REPORT

Application Number
EP 96 30 1584

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int.Cl.6)
P,X	WO-A-96 00101 (TARGET THERAPEUTICS INC) 4 January 1996 * page 16, line 3 - line 23; figure 6 *	1-9	A61M25/00
X	US-A-5 019 057 (TRUCKAI) 28 May 1991 * the whole document *	1-9	
X	US-A-5 057 092 (WEBSTER JR.) 15 October 1991 * the whole document *	1-9	
A	EP-A-0 358 117 (ADVANCED CARDEOVASCULAR SYSTEM) 14 March 1990 * the whole document *	1-9	

TECHNICAL FIELDS SEARCHED (Int.Cl.6)

A61M

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
THE HAGUE	12 August 1996	Clarkson, P

CATEGORY OF CITED DOCUMENTS

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